Project A-610

INVESTMENT CASTING

A Manufacturing Possibility for Elberton, Georgia

Prepared for

The Elbert County Redevelopment Corporation

by

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Foreword

This is the first of two special product-industry studies prepared for the Elbert County Redevelopment Corporation as part of a comprehensive program of technical assistance for the industrial development of Elberton and Elbert County. Both of these studies are concerned with opportunities for diversifying the industrial economy of the county, which is presently heavily dependent upon the granite and apparel industries.

This report examines the possibility of establishing an investment-casting operation in Elbert County. The attractiveness of this opportunity is enhanced by Elberton's location in relation to the southeastern market, the lack of competition in the area, the potential adaptability of worker skills to this type of operation, and the assistance available to a manufacturer because of Elbert County's classification by the Area Redevelopment Administration as a redevelopment area.

Questions or comments concerning either this particular report or the over-all study are invited.

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Summary

Elbert County would be an excellent location for an investment-casting operation for the following reasons:

1. It is very well located for serving southeastern users of investment castings (Map 2).
2. Elbert County labor is already adapted to many tasks common to foundry operations and the granite industry.
3. Wage rates for skilled workers are lower than those in more industrialized areas.
4. Elbert County is eligible for Area Redevelopment Administration assistance in the fields of financing, technical assistance, and occupational training.

In a short span of 25 years investment casting has emerged as an industrial metal-forming process with production valued at over $100 million per year. This expansion has been due primarily to the adaptability of many metals and alloys to the casting method and the quality characteristics of the finished product.

An investment-casting foundry can economically be a small operation employing fewer than 100 production workers. Foundries such as this in the North and Far West are now supplying the bulk of the investment castings consumed in the Southeast.[1/]

In order to produce $400,000 worth of investment castings, in addition to technical "know-how" a prospective foundry would need:

1. A fireproof building with 5,000 square feet of floor space and adequate utilities.
2. Twenty to twenty-five production workers.
3. $30,000 to $40,000 worth of production equipment.
4. A total investment of approximately $150,000.

The southeastern investment-casting market, amounting to $5 million to $6 million, could possibly be increased substantially if serviced from within by a capable foundry. Proximity to the market would enable a foundry to offer customers good communication and coordination, reduction in production and delivery times, and freight savings. A Georgia foundry producing $400,000 worth of investment castings can also, because of lower wage rates, realize labor

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1/ Alabama, Florida, Georgia, North Carolina, South Carolina, and Tennessee.

cost savings of between $24,000 and $38,000 over competitors producing similar volumes in states presently shipping to the Southeast. A net profit after Federal income tax of 16% on investment is anticipated.

INTRODUCTION

Purpose

The purpose of this report is to review the background requisites and potential of investment casting so as to determine the feasibility of establishing an investment-casting foundry in Elberton, Georgia, to serve an existing and growing southeastern market which presently is being supplied from foundries in the Northeast, Midwest, and Far West.

The Industry

Although investment castings have been known and used for many years by art craftsmen, it has been only since World War II that the process has come into its own as a tool for industry. In this short time the value of investment castings shipped has increased to over $100 million per annum.

The investment-casting method is adaptable to all metals and alloys capable of being cast. In 1958 about 80% of investment castings were of ferrous metals. Over the past few years, however, the volume of nonferrous castings has increased substantially. The present comparison of ferrous to nonferrous investment castings would be a 60%-40% ratio.

The long-range trend in the demand for more complex components and the increased use of alloys serves to expand industry requirements for investment castings. The investment-casting process offers tremendous design flexibility. Single-piece castings may be made to replace multipiece assembled or welded parts at a great advantage in quality, economy, and appearance. Because almost any metal or alloy may be investment cast, the choice of raw material can depend solely upon end use of the finished part. Other advantages of investment castings are:

1. dimensional accuracy and consistency,
2. exacting tolerances requiring minimum machining, and
3. excellent "as cast" finishes.

There may also be rigid specifications of material and design requiring a one-piece component that can be formed only by investment casting.

An investment-casting foundry is well suited to be a small-scale operation. According to a survey made by Precision Metal Molding, almost 90% of the

investment-casting production workers are employed in plants with less than 100 workers. Of the more than 100 investment-casting companies listed in industry directories it is estimated that fewer than 10 have an annual sales volume of $2 million.

Map 1 shows the location by state of foundries whose major business is the sale of investment castings to outside customers. Captive investment-casting plants are not included. At the present time none of the foundries shown has a branch in the Southeast.

MAP 1

LOCATION AND NUMBER OF INVESTMENT-CASTING FOUNDRIES IN THE U. S.

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MARKETS

National Market

Since 1958 there has been a steady annual increase in the national consumption of investment castings. The Investment Casting Institute placed the 1960 shipments of investment castings at approximately $87 million, up from $79 million in 1958. By 1963 the volume had grown to $107 million and the Institute estimates the 1964 figure to be about $117 million.

Much of the increase is attributed to the recent recognition of investment castings by a large number of industries which heretofore used other means of metal forming. The electronics, textile machinery, food machinery, computing machinery, metalworking machinery, and industrial valve industries are relatively new converts to investment castings. Because of this interest, the long-range growth potential of the investment-casting industry appears very bright.

Southeastern Market[1/]

To determine the southeastern market for investment castings a direct approach was used. A large number (500) of metalworking companies in the southeastern area were solicited by questionnaire to determine their present and future investment-casting needs. (See Appendix 1.) These companies were selected solely on the basis of their possible use of metal castings.

Of the 225 replies received, 29% were presently buying investment castings. (See Map 2.) The volume of these purchases was almost $2.5 million. Thirty plants using investment castings anticipated that their requirements would increase from 10% to 100% within the next few years. In addition, a number of firms which did not use investment castings indicated a future interest, should a reliable southeastern foundry become available.

From discussions with foundry representatives and equipment manufacturers a six-state investment-casting consumption of between $5 million and $6 million has been approximated. This figure seems reasonable when corroborated by the results of the questionnaire.

1/ Alabama, Florida, Georgia, North Carolina, South Carolina, and Tennessee.

MAP 2

LOCATIONS OF CITIES OF KNOWN USERS OF INVESTMENT CASTINGS IN THE SOUTHEAST

EQUIPMENT AND LABOR REQUIREMENTS FOR AN INVESTMENT-CASTING FOUNDRY

Although it is advantageous for an investment-casting foundry to have a complete die-shop department, satisfactory work can be obtained by working in close liaison with an adequate tool and die shop. A good tool maker, with facilities costing but a few thousand dollars, can turn out good dies, tools, and patterns by working in conjunction with a die shop.

An investment-casting operation is divided into four sections. They are:

1. wax department,
2. investment department,
3. melting department, and
4. cleaning and finishing section.

In the wax department patterns are produced, trimmed, and inspected. If acceptable, they are connected by wax and a tree is formed. The basic equipment requirements for this department would be wax-injection presses, soft metal wax-mold equipment, and facilities for hand assembling gates and trees. The cost to equip the wax room should be about $3,500. One-third of the plant's production workers would be employed in this section.

The investment department should be air-conditioned and humidity-controlled. Its equipment should include mixers, vibrating tables, and material-handling facilities for ceramics. In this department the trees are precoated, dried, and invested by one-sixth of the company's production personnel. The equipment cost would be about $4,000.

The melt department requires the heaviest financial investment. Essential equipment would be ceramic kilns, induction furnaces, and centrifugal casting machines. The mold burnout equipment would cost $4,000 and the melt and cast equipment about $15,000. Good atmosphere and temperature control is necessary for this department. In addition, there should be some means of wax reclamation. In this section molds are burned out and fired and the metals are poured into the forms. After the molds are cooled, the castings are removed. One-sixth of the workers (three to five men) can maintain and operate this department.

In the clean-up and finishing section the individual castings are sand-blasted and cut off from the tree. The gates are removed and the castings are

deburred and straightened. The finishing and cleaning apparatus, consisting mainly of shake table, cut-off machine and sand-blast machine, should cost about $5,000. Dust collectors would cost about $1,500. The remaining one-third of the foundry's production labor (six to eight men) would be in this group.

Final inspection, which is skilled work, can be handled by the manager or tool maker plus an assistant.

The investment-casting operation utilizing this equipment should be in a fireproof building, at least partially air-conditioned, with between 4,000 and 5,000 square feet of floor space. Such a plant would be capable of handling 200 pounds of finished castings per day. On a one-shift basis, it would employ 20 to 25 production workers. The anticipated sales volume for such a foundry is $400,000 per annum.

The investment-casting foundry described above would require an investment of $150,000. The return on this investment after Federal taxes should be about 16%. (See Appendix 4.)

ELBERTON AS A LOCATION FOR INVESTMENT CASTING

At the present time manufacturing in Elberton is essentially confined to the granite, textile, and apparel industries. However, the very nature and background of the people and the county's central location in the southeastern area contribute toward making Elberton an excellent city in which to establish an investment-casting foundry. As Map 2 indicates, Elbert County is well located to serve the southeastern market.

Labor Supply and Skills

There is a substantial labor pool available within easy commuting distance of Elberton. From this pool manufacturers can readily recruit the production workers necessary to run an investment-casting foundry.

The Elbert County labor supply in 1962 numbered over 3,000 persons, of which 40% were men. Although not foundrymen, many of these workers are familiar with the procedures and tools used in investment casting. Men who have worked in the granite industry are very well suited to operate the grinding, sand-blasting, and finishing equipment in a casting plant. Many of the women with experience in the garment and textile industries have the finger dexterity required for wax-welding patterns onto gates and trees.

Precision casting should come naturally to workers in Elberton. Many are skilled and trained for quality work in granite and are regarded as artists with considerable pride of accomplishment.

These people should understand the job-shop orientation of the casting industry and would be accustomed to the heat of the foundry, which is comparable to that of the quarries.

Labor Cost Savings

According to the Georgia Department of Labor, the ranges for wage rates in Elbert County in December 1962 were:

	Per Hour
Unskilled	$1.15 to $1.30
Semiskilled	$1.30 to $2.00
Skilled	$2.06 to $2.40

These wage scales are well below those for investment-casting workers in any section of the country. Therefore, the establishment of a foundry in Elberton could conceivably result in substantial labor savings for such an operation.

The greatest percentage of investment-casting foundries employ 20 to 50 production workers. Of these, one-sixth should be skilled and the rest should be divided into an almost equal number of semiskilled and unskilled workers. The average wage rate for this labor combination in Elberton would be about $1.90 per hour. This figure is considerably below the production wage rates in iron and steel foundries in any of the states producing large tonnages of investment castings.

The wage rates for production workers in iron and steel foundries (SIC 332) in states presently supplying much of the investment castings consumed in the Southeast are shown in Table 1.

Table 1

AVERAGE PRODUCTION WAGE RATES IN IRON AND STEEL FOUNDRIES IN 1958

State	Average Hourly Wage Rate
Michigan	$2.70
Pennsylvania	2.54
Ohio	2.53
Illinois	2.51
New York	2.38
Massachusetts	2.34
California	2.33

Source: Derived from data in U. S. Census of Manufactures, 1958

The above figures indicate that Elberton can offer foundries the following reductions in labor costs over these states:

Michigan	29.6%
Pennsylvania	25.2%
Ohio	24.9%
Illinois	24.3%

New York	20.2%
Massachusetts	18.8%
California	18.4%

Production labor costs average 32.6% of the value of shipments of iron and steel castings, according to the 1958 Census of Manufactures. By multiplying this cost percentage by the value of shipments and then by Elberton's labor savings percentage over each state, the anticipated labor cost reduction for an Elberton foundry with sales of $400,000 can be calculated:

Michigan	0.326	x	$400,000	x	0.296	= $38,600
Pennsylvania	0.326	x	$400,000	x	0.252	= $32,900
Ohio	0.326	x	$400,000	x	0.249	= $32,500
Illinois	0.326	x	$400,000	x	0.243	= $31,700
New York	0.326	x	$400,000	x	0.202	= $26,300
Massachusetts	0.326	x	$400,000	x	0.188	= $24,500
California	0.326	x	$400,000	x	0.184	= $24,000

The above labor cost savings are equal to an additional profit on sales of 6.0% to 9.6%.

In addition, Georgia workers have an excellent work attendance record. During the three years from 1961 through 1963 the ratio of work stoppage to total working time was less in Georgia than in any of the aforementioned states.

Other Assets

Labor Relations. There is in Elbert County a mature relationship between industry and labor organizations. The granite industry and textile and apparel companies are presently working under labor contracts with the best possible cooperation between management and unions.

Area Redevelopment Administration Benefits. Elbert County is an approved Area Redevelopment Administration area. This makes a manufacturer eligible for the following types of assistance from the Federal government:

1. low-cost financing for plant and equipment,
2. technical assistance in the form of technical information and market research, and
3. occupational training assistance.

Transportation. There are four local freight carriers operating out of three local terminals. In addition, over 30 truck lines are authorized to serve Elberton and Elbert County.

Utilities. The city of Elberton purchases electric power for distribution through its own utility system. Also serving the county community are the Georgia Power Company and the Hart County Electric Membership Corporation.

A number of locations suitable for an investment-casting foundry are available in the Elberton area.

SALES ADVANTAGES OF AN ELBERTON INVESTMENT-CASTING FOUNDRY

A foundry operation located in Elberton, Georgia, would have tremendous sales appeal to prospective buyers of investment castings in the Southeast because of:

1. Closer coordination and communication between customer and foundry. There would be greater proximity between designer, engineer, and foundryman. This would diminish the number of errors, and those that would occur would likely be smaller and less costly.
2. Reduction in casting production time. With the purchaser's technical staff readily available to check and advise, fewer time-consuming problems should present themselves.
3. Shorter delivery time. From a foundry in Elberton, first-morning delivery would be available to a large portion of the southeastern area, in comparison to as much as six- or seven-day delivery from other plants. (See Map 3.)
4. Freight savings. Trucking rates from Elberton to points in the Southeast are less than the rates to the same points from cities outside the area.

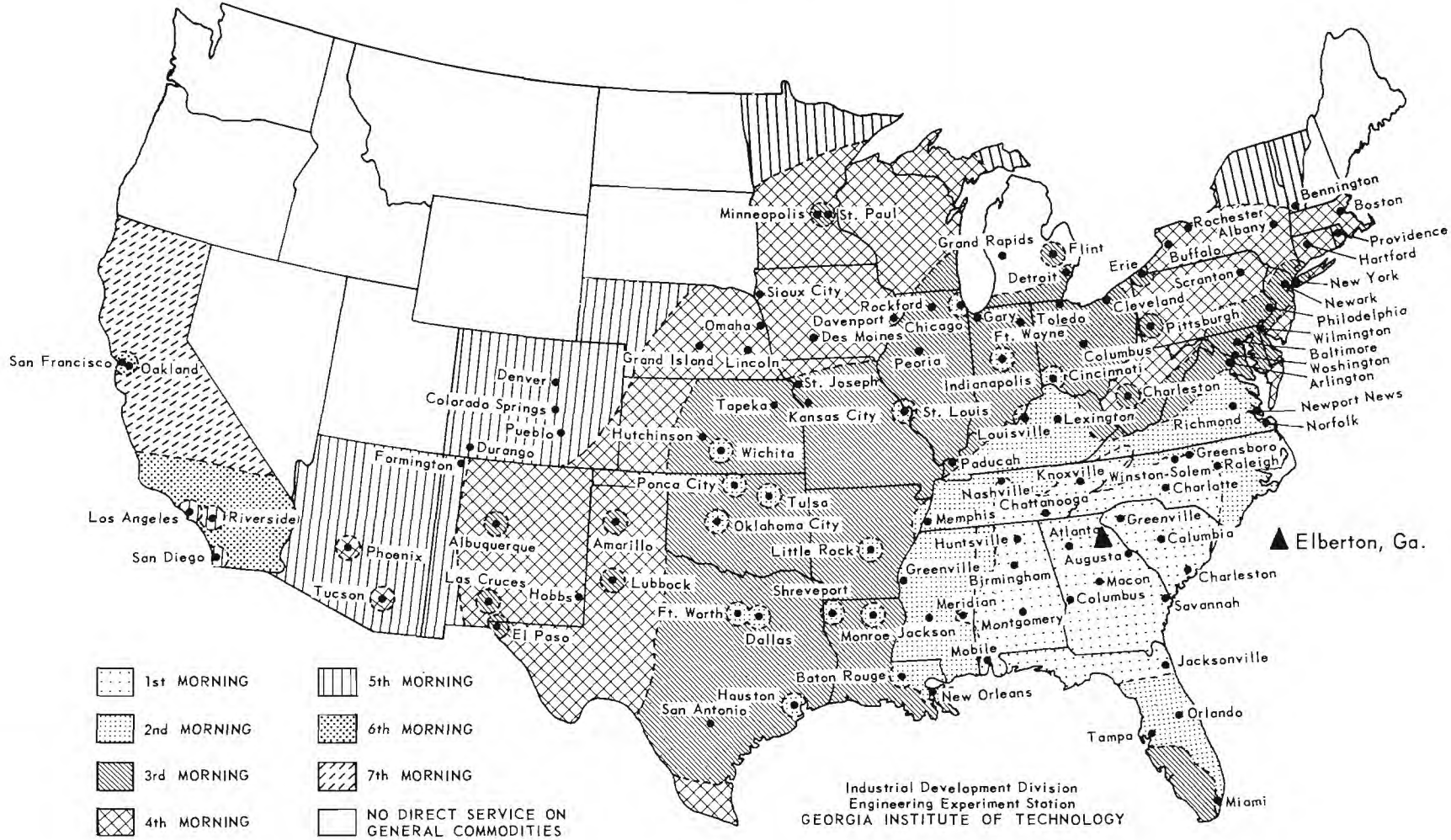
The foundry would also benefit by:

1. a greater knowledge and understanding of individual customer needs, and
2. a decrease in time necessary for submitting quotations and evaluating and processing orders.

As a result of savings in both time and money, a foundry in Elberton, Georgia, serving the southeastern states would be in a position to offer lower quotations than its competitors from other sections of the country for the same margin of profit.

MAP 3

TRANSIT TIMES ON DIRECT LESS-THAN-TRUCKLOAD SHIPMENTS
Base Point: Atlanta



APPENDICES

Appendix 1

QUESTIONNAIRE

INVESTMENT CASTINGS

Principal Products _____

Number of Employees _____

1. What is your annual consumption of investment castings in dollar values?

Metal	Volume
Ferrous	$_____
Cobalt or Nickel Base	_____
Nonferrous	_____
Other	_____

2. What per cent of the above do you produce in your own company? _____

3. What increase in the use of investment castings do you now contemplate?

_____

4. Would additional investment casting facilities close to you affect your consumption? _____

5. To what extent? _____

Comments: _____

_____

_____

_____

Appendix 2

ADVANTAGES OF INVESTMENT CASTING OVER OTHER METHODS

DIE CASTING

1. Lower tooling costs
2. Faster deliveries
3. Wider range of alloys
4. Any order quantity practical
5. Generally sounder castings
6. Fewer design limitations

SAND CASTINGS

1. Better surface finishes
2. Fewer design limitations
3. Wider range of alloys
4. Generally sounder castings

POWDERED METAL

1. Lower tooling costs
2. Faster deliveries
3. Wider range of alloys
4. Any order quantity practical
5. Sounder parts; closer grain structure
6. Fewer design limitations

PERMANENT MOLD CASTING

1. Lower tooling costs
2. Wider range of alloys
3. Any order quantity possible
4. Sounder castings
5. Fewer design limitations

FORGINGS

1. Lower tooling costs
2. Faster deliveries
3. Fewer design limitations

Appendix 3

HERE ARE THE STEPS IN INVESTMENT CASTING

1. A permanent machined metal die is produced to a fine degree of accuracy.
2. Wax or plastic is injected into the mold to form the pattern. The patterns are removed and allowed to age.
3. After ageing, the patterns are wax-welded into "trees" or clusters.
4. The tree is placed in a flash and investment (a silica-base plaster) is added, completely surrounding the patterns.
5. After the investment material hardens, the wax patterns are melted away from the investment mold.
6. Molten metal is forced into the mold either by centrifugal force or with a vacuum assist.
7. When the mold has cooled, the investment material is broken away from the castings.
8. The "gates" are removed and each piece is ground and finished.

Appendix 4

PRO FORMA COST SHEET

Sales		$400,000
Direct Materials		$150,000
Supplies		5,000
Utilities		1,600
Depreciation:		
Equipment	$4,000	
Building	1,250	5,250
Direct Labor		100,000
Indirect Labor		35,000
Sales Expense		32,000
Miscellaneous:		
Freight out, travel discounts, allowances, bad debts, contingencies		26,000
		$354,850
Profit before Taxes		$ 45,150
Net Income after Federal Taxes		$ 23,500